

ILRS Standardization of Hardware, Software, and Procedures: Extending the Range

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Introduction

What level of standardization best promotes the goals of the ILRS?

- Current status
- What is/can be standardized?
- How are standards enforced?
- LR Station Reference design

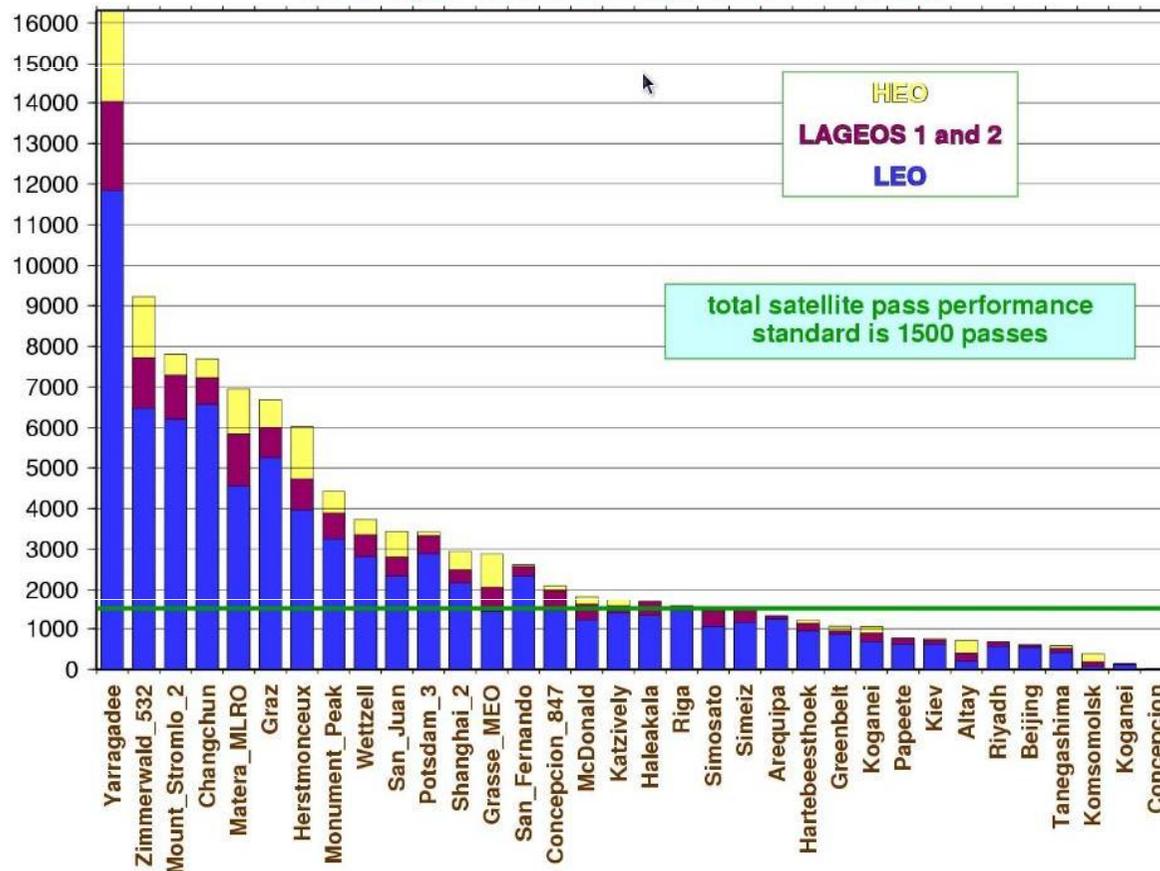
Standardizing on Performance

- Yearly Data Quantity Guidelines
 - 1000 Low Earth Satellite (LEO) passes
 - 400 LAGEOS 1,2 passes
 - 100 High Satellites passes
- Data Quality Guidelines
 - 1 cm LAGEOS normal point precision
 - 2 cm short term bias stability
 - 1 cm long term bias stability
- Operational Compliance Guidelines
 - Data delivery with 12 hours (latency)
 - Specified ILRS normal point format
 - Current site and system information form (i.e., site log)

Also, standard procedures, algorithms, formats, and software are on the web site

Quarterly Report Card

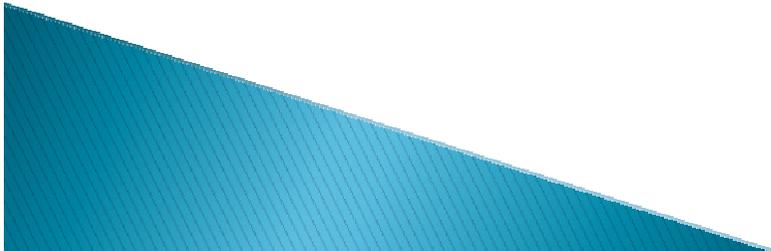
total passes
from April 1, 2010 through March 31, 2011



What do we want from standardization?

- Encourage reliable, accurate performance
- Provide the best, mature methods
- Reduce cost of design and maintenance
- Reduce duplication of effort
- Permit innovation and flexibility
- For software, both the algorithm and software to implement it are desirable

A good standard is a resource, not a ball and chain



Who Is Involved?

- Stations (Most of our discussion lies here)
 - Hardware, software, procedures
- Operations Centers
 - Procedures
- Data Centers
 - Procedures
- Analysis Centers
 - Procedures

Hardware (Stations)

- Time standards (GPS, cesium, etc.)
- Laser (10Hz, 100Hz, 2kHz)
- Range gate generator
- Timers (event and interval; some to avoid)
- Detectors (APD, SPAD, MCP)
- Calibration piers
- Radar
- Telescope/dome/infrastructure

Every station (network) is its own standard

Procedures (Stations)

- Surveys (how often; what gets surveyed)
- Range calibrations (how often, etc.)
- Prediction and restriction (Go/No-go) downloads
- Ranging data uploads
- Status messages (NASA LORs; EUROLAS real-time status)
- Adding new targets
- Site log maintenance
- Station change notice (for data quarantine)

Some of these are already standardized

Procedures (Centers)

- Operations centers

- Data ingestion (schedule; location)
- Data screening (format checks; data quality checks)
- Quarantine data handling
- Data distribution (schedule; location)

- Data centers

- Data ingestion (schedule; location)
- Data distribution and reporting

- Analysis centers

- Data ingestion
- Data screening and fitting
- Data product creation and distribution

A work in progress

Procedures (Centers) II

- There are still inconsistencies in meaning of daily files (CDDIS/EDC). Seems to be OK with users.
- EDC and NASA OCs use different screening checks
- Centers are coming to agreement on quarantine procedures

Software/Algorithms (Station Data Acquisition)

- Telescope mount model fitting (candidate)
- Star / planet prediction / Refraction (USNO NOVAS; RAL SLALIB; JPL; Mendes/Pavlis)
- Sun avoidance (candidate)
- Tracking restrictions (candidate?) Formats in place.
- Prediction sample routines: CPF read/write/check/interpolate/convert
- Range data sample routines: CRD read/write/check/convert
- Challenges: Hard to go beyond this level, as software may be
 - O/S- and library-dependent (coding standards; GUIs)
 - hardware-dependent, depending on level of hardware abstraction used

Software/Algorithms (Station Data Processing)

- Prediction download/preparation and data upload
- Data pre-filtering, e.g. Poisson filtering (candidate)
- Normal point generation (candidate)
- Data distribution statistics: *distrib*
- CPF /CRD sample routines: read/write/check
- Normal point checking: *npcheck*

Need more standard station software/algorithms

Software/Algorithms (Centers)

- CRD/CPF sample code: checking/conversion
- POD software:
 - GEODYN (JCET, ASI, GA) - EPOS (GFZ)
 - DOGS (DGFI) - GINS (GRGS)
 - SATAN (NSGF) - NAPEOS (ESA)
 - Bernese (BKG)
- IERS Conventions (currently 2003) is the standard for gravity field, ocean loading, tides, refraction models, constants, etc.

Mainly performance based

Standards Enforcement

- Need some type of enforcement for standards to mean anything
- The ILRS is a volunteer organization, but stations have united to gain benefits from cooperating
- Education: Ensure every ILRS component knows standards and their benefits
- Report card and the station “cut line”

SLR Reference Design - I

- Proposal: maintain an SLR station reference design, probably on the ILRS website
- Incorporate the best, proven and available hardware and software and “best practices” procedures, providing viable alternatives and compatibility with other components
- Need not be built, but is a starting point for any group wanting to build or update an SLR station

SLR Reference Design - II

- Block diagrams of hardware, software and procedures
- List of manufacturers
- List of deprecated components
- Reference articles by subsystem
- List of “experts” for each component or subsystem
- Augments existing standards on the ILRS web site

Conclusion

- Absolute standardization is not possible
- Current standardization on performance, not hardware and software is probably best
- Must enforce standards to be of any value
- More “standard” software should be made available on the ILRS web site
- Maintaining some type of standard reference system or list of inter-operating critical components could be helpful